IN THE SPECIFICATION

Page 5, lines 30-33 have been amended as follows:

A further object of the invention is to provide a method of ~~regeneration~~ **regenerating** a dirty solution from such a cleaning and/or treatment device, which method is effective and simple.

Page 9, line 13 to page 11, line 28 have been amended as follows:

It is preferred that the filter unit comprises a solid membrane filter. The membrane may have any thickness e.g. from 1 mm to 1 cm. The membrane may preferably have pore size between 10 - 10,000 kD or between 0.001 - 5 μm. The membrane filter can be made from any suitable material such as ceramics, graphite, metals, metaloxides, papers and polymers. In the present invention, it is particularly preferred that the membrane filter comprises a membrane made of one or more materials selected from polymeric materials, ceramic materials, and metals.

The structure of the membrane may be symmetric (meaning that the pore diameters do not vary over the membrane cross section) or it may be asymmetric so that the pore diameters increase from one side of the membrane to the other by a factor of up to about 100.

Suitable membrane filters are described in DE patent publication 26 53 875, US patent No. 4,915,837, US patent No. 4,726,900, US patent No. 4,990,256 and US patent No. 5.681,469, which are hereby incorporated by reference.

The membrane filter of the filter unit is preferably packed in a flat, spiral wound, tubular fibre type configuration. Most preferred are tubular fibre type configurations, such as "spaghetti" or hollow tubular fibre type configurations.

In a cross-flow filter, no filter cake formation or "in-depth" filtration takes place. The filter surface should be sufficiently open to allow for water to pass it. It is preferred that the filter surface is sufficiently open to allow for unused detergent to pass it. At the same time, it is preferred that the filter surface should not be more open than this so that it is able to retain essentially all of the particles that cause turbidity in the recycled solution. Thereby, visual deterioration of the cleaning result (floor appearance etc.) may be avoided.

In a particularly preferred embodiment of the cleaning device of the invention, particularly a floor scrubber or a carpet cleaner, the filter unit further comprises a coarse screen unit for precleaning the dirty solution before it enters the membrane filter. This coarse screen unit may ~~comprises~~ **comprise** one or more screens preferably having a mesh width in the range

50 - 2.000 μm. In most situations, it is sufficient if the coarse screen unit comprises one or two screens.

If the cleaning device should be used in cleaning very dirty surfaces, particularly dirty floors such as floors in automobile shops, it is preferred that the coarse screen unit comprises multiple screens, e. g. up to 5 coarse screens, with decreasing mesh width, arranged in a sandwich structure.

In a preferred embodiment of the invention, the cleaning device further comprises a pumping means for pumping clean solution from the clean solution tank in a back-flush through the filter unit, whereby the filter unit is regenerated.

When the pumping means for pumping clean solution from the clean solution tank in back-flush through the filter unit is in operation, the pumping means for pumping dirty solution through the filter unit may continue operating.

It is preferred that the pumping means for pumping clean solution from the clean solution tank in a back-flush through the filter unit is controlled by an automatic control unit for starting and stopping said pumping means. More preferably, all of the pumps and the valves of the cleaning device are controlled by an automatic control unit.

Furthermore, it is preferred that the cleaning device is constructed in a way whereby the filter unit, the pumps and the valves of the device are easy to access.

The present invention also comprises a cleaning device in combination with a filtering station. In this aspect of the invention, the cleaning device is separated from the filter unit, but is adapted to be connected to the filter unit for regeneration of dirty solution, preferably by use of a snap lock device or a quick connection. Such snap lock devices and quick connections are generally known.

Page 11, line 33 to page 13, line 24 have been amended as follows:

The invention further comprises a process of recycling solution containing detergent and water in a cleaning device or a cleaning device in combination with a filter station.

In the process according to the invention, clean solution is transported from the clean solution tank to the cleaner head and through the supply opening of the cleaner head onto the surface to be cleaned e.g. a floor or a carpet. The amount of solution transported through the supply opening may preferably be from 0.1 to 20 l/min. Used solution is recovered through the recovery opening of the cleaner by use of a suction means, such as a pump or a suction device,

and the recovered dirty solution is transported to the dirty solution tank. It is preferred that at least 60% by volume of the solution is recovered. In some preferred embodiments of the invention, up to about 100% of the solution can be recovered. In order to recover as much dirty solution as possible, the solution on the surface to be cleaned may be collected by use of a squeegee mounted on the cleaner head. Such arrangements are generally known from the art.

Dirty solution is transported from the dirty solution tank through a filter unit comprising a cross-flow filter. From this filter unit, concentrated dirty solution is returned to the dirty solution tank, and filtered cleaned solution is transported to the clean solution tank for reuse. The pressure on the dirty solution side of the filter unit may be 0.5-10 bar. A typical flow rate through the cross-flow filter is 0.1-4.0 $l/min/m^2$.

With regular intervals, preferably from 1 to 20 times per minute, more preferably from 1 to 10 times per minute, the filter unit is preferably regenerated by pumping clean solution from the clean solution tank in a back-flush through the filter unit.

~~**The duration of each**~~ **Each** step of pumping clean solution from the clean solution tank in a back-flush through the filter unit may have a duration of from 0.5 to 10 seconds. An automatic control unit may preferably regulate the intervals and duration of the back-flush procedure.

The cleaned solution may preferably be recirculated to the clean solution tank at a flow of about 0.1 to 1,000 l/hr. The optimal speed of recirculation depends largely on the solution consumption of the cleaning device under operation. Preferably, the speed of recirculation of the clean solution should correspond to the speed of consumption.

The concentration of detergent and/or treatment chemicals in the solution **[[depend]]** **depends** on the type of detergent/treatment chemicals, the type of surface that is to be cleaned/treated, and the type of dirt to be removed from this surface. In most situations, however, a detergent solution having a detergent concentration in the range 0.001 - 25 % by weight is suitable for cleaning surfaces.

DESCRIPTION OF THE DRAWINGS

The invention is described in further detail with reference to the following figures and examples:

Page 17, line 12 to page 19, line 21 have been amended as follows:

When the recycling system works in its first mode, dirty solution is sucked through the course screen F1 using the pump P1, and a solution stream flows through pipeline D1. The course screen F1 stops large particles from entering the membrane filter unit F2 and valves V3 and V4, and the filter unit and the valves are consequently prevented from clogging. After passing through pipeline D1, the solution flows through membrane filter unit F2. The membrane filter unit comprises a cross-flow membrane as it is shown in fig. 2. The solution flows into the filter unit F2 through opening 01 on the dirty side A, where it passes along the membrane M. Some water and detergent pass through the membrane M and enter the clean solution side B, and exit the filter unit F2 through opening 03 into pipeline C1. The concentrated dirt and solution mixture leaves the filter unit F2 through opening 02 into pipeline D2. When the recycling system works in its first mode, valve V3 is closed while the passing through valve V4 is adjusted so as to obtain a suitable pressure difference over the membrane M e.g. 0.5 to 10 bar. The dirty solution concentrate returns to the dirty solution tank through pipeline D3. Valve VI is open, and the solution from pipeline Cl flows freely through valve V1 and the check valve V5, which stops air from entering the filter unit F2. The solution from pipeline C1 flows into the clean solution tank. Valve V2 is closed and pump P2 is turned off when the system is working in its first mode. The size of solution stream in pipeline C1 compared to the size of solution stream in pipeline D2 is determined by the back-pressure created by valve V4 and the resistances of the membrane, so that any settlement of dirt on the membrane is avoided. The back-pressure is chosen according to the tolerance of the membrane M, and the establishment of a cross-flow through pipeline D2 large enough to transport all dirt entering the filter through pipeline D1 back to the dirty solution tank S2.

For regular cleaning of the membrane M, a back-flush mechanism is used. This back-flush mechanism is operating when the system is working in its second mode. When the back-flush mechanism is turned on, valve V3 is opened to reduce the trans-membrane pressure, valve V1 is closed, valve V2 is opened and pump P2 turned on. All of the solution stream passing through pipeline D1 then flows directly through filter unit F2 and into pipeline D2. From pipeline D2[[.]], the solution stream splits into pipelines D3 and D4, from where it flows into the dirty solution tank S2. The pump P2 is started, and a clean solution stream flows from the clean solution tank S1 into the pipeline C2, where it passes through check valve V6 and the open valve V2. The clean solution stream from pipeline C2 flows into the filter unit F2 through opening 04

on the clean side B of the membrane M, and it passes along the membrane M. The clean solution passes through the membrane M and enters the dirty solution side A. When the clean solution passes through membrane M from the clean side B to the dirty side A, the membrane M is regenerated. After having passed the membrane M, the solution flows, along with the dirty solution from pipeline D1, out in pipeline D2.

The construction and design of the membrane filter unit F2 is not crucial for the recycling system to work; this is shown later on in example 5. The cross-flow operation of the filter is important and distinguishes this technology from used methods of in-depth filtration. Thus, it is particularly preferred that the membrane filter unit F2 uses a cross-flow principle as it is illustrated on fig. 2. where water and detergent (and possibly treatment chemicals) cross the membrane M, while dirt just passes along the membrane M.

Fig. 3 shows another preferred recycling system of a cleaning device according to the invention. The device is transported on wheels Wand is supposed to be moved in the direction shown by the arrow when in use. The recycling system comprises a clean solution tank S1' and a dirty solution tank S2'. The recycling system comprises a coarse screen Fl', a membrane filter unit F2', valves V1', V2', V3', V5' and V6'; pumps P1' and P2'; pump /suction device P3'; and pipelines CO', DO', D1', D2', D3', C1', and C2'.

Page 19, line 26 to page 21, line 12 have been amended as follows:

When starting using the cleaning device, the solution tank S1' is filled with fresh solution. The solution flows through pipeline CO' from the solution tank S1', and down to a cleaner head, not shown. Dirty solution is recovered using pump/suction device P3', and transported through pipeline DO' to the dirty solution tank S2'. A coarse screen F1'is placed inside said dirty solution tank S2'.

When the recycling system works in its first mode, dirty solution is sucked through course screen F1' using the pump P1', and a solution stream flows through pipeline D1'. After passing through pipeline D1', the solution flows through membrane filter unit F2'. The membrane filter unit comprises a cross-flow membrane M as it is shown in fig. 2 and described above. The clean filtered solution exits the filter unit F2' through pipeline C1'. The concentrated dirt and solution mixture leaves the filter unit F2' through pipeline D2'. When the recycling system works in its first mode, the flow passing through valve V3' is adjusted so as to obtain a suitable pressure. The dirty solution concentrate returns to the dirty solution tank through

pipeline D3'. Valve V1' is open, and the solution from pipeline C1' flows freely through valve V1' and the check valve V5', which stops air from entering the filter unit F2'. The solution from pipeline C1' flows into the clean solution tank S1'. Valve V2' is closed, and pump P2' is turned off when the system is working in its first mode.

For regular cleaning of the membrane, a back-flush mechanism is used. This back-flush mechanism is operating when the system is working in its second mode. When the back-flush mechanism is turned on, valve V3' is adjusted to reduce the trans-membrane pressure, valve V1' is closed, valve V2' is opened and pump P2' is turned on. All of the solution stream passing through pipeline D1' then flows directly through membrane filter unit F2' and into pipeline D2'. From pipeline D2', it flows via pipeline D3' into the dirty solution tank S2'. The pump P2' is started, and a clean solution stream flows from the clean solution tank S1' into the pipeline C2', where it passes through check valve V6' and the open valve V2'. The clean solution stream from pipeline C2' flows into the filter unit F2' on the clean side B of the membrane M, and it passes along the membrane M. The clean solution passes through the membrane M and enters the dirty solution side A. When the clean solution passes through membrane M from the clean side to the dirty side, the membrane M is regenerated. After having passed the membrane M, the solution flows, along with the dirty solution from pipeline D1', out in pipeline D2'.

Example 1

Before a separation test, the turbidity (NTU) of the tap water and the solution with different detergent concentrations was measured using a turbidity meter. The turbidity of the cleaning solution as a function of cleaning agent concentration is shown in table 4.

Page 27, lines 15-35 have been amended as follows:

Example 4

In this example, about 500 ml "CAA (CAA) " is mixed in about 105 litre tap water (TW). The solution (S1) is approximately a 0.5% "CAA" solution. Solution "S1" is filled into the clean solution tank of a floor scrubber according to the invention. The floor scrubber used was a BR 1000 as used in example 1 which was equipped with a recycling system as it is schematically shown in figure 1. The cross-flow separator used was a separator type CFP-1-D-9A.

The characteristics of the solution were measured using both turbidity (NTU) and the surface tension (in dyn/cm) of the solution. Cleaning of a warehouse floor was performed for about 35 minutes. A permeate flow of about 150 1/hr was obtained. Automatic back-flush of

[[in]] 2 sec/min was used. About 65 litres of filtered solution (FS1) were produced, and about 40 litres remained in the dirty solution tank. The recycling system including the back-flush system is shown in figure 1.

Page 28, line 11 to page 29, line 2 have been amended as follows:

Now, the 65 litres of the above filtered solution FS1 were mixed with about 20 litres of water (TW) including about 75 ml CAA into the clean solution tank. The volume in the clean solution tank was now about 85 litres and the surface tension of the solution (S2) was measured to about 30 dyn/cm. Cleaning was performed for about 32 minutes and about 80 litres of recovered and filtered solution (FS2) were collected. Automatic back-flush **(2sec/30sec)** ~~(2sek/30sek)~~ was used. The surface tension of filtered solution FS2 was measured to about 32 dyn/cm.

Hereafter, the 80 litres of the above recovered solution RS2 were mixed with about 20 litres of water (TW) including about 1.80 ml CAA into the clean solution tank. The volume in the clean solution tank was now about 100 litres and the surface tension of the solution (S3) was measured to about 30 dyn/cm. Cleaning was performed for about 31 minutes and about 85 litres of filtered solution FS3 were collected. A permeate flow of about 135 l/hr was obtained. Automatic back-flush **(2sec/30sec)** ~~(2sek/30sek)~~ was used.

Page 30, line 8 has been amended as follows:

Example 5

Page 30, line 17 to page 31, line 12 have been amended as follows:

A floor scrubber as used in example 1 was filled with a 0.5 % solution of detergent CAA. ~~As a separator, a~~ **A** membrane type CFP-1-D-9A was used **as a separator**. Samples were taken out of the stream from the separator to the clean solution tank after 0, 18 and 30 minutes after the scrubbing and recycling process was started, and further samples were taken from demineralized water without detergent, and dirty solution.

On a clean surface, an average gloss on five separate areas was measured. Then, a 50 μm layer of the test samples of the solutions was tape-casted out on the areas. The surface was left to dry, and an average gloss was measured again afterwards.

In diagram 5, the gloss of the surface areas before and after is shown. It is seen that the dirty solution gives a high reduction in gloss (<30) while the filtered solution keeps the gloss

(70-75). The solution quality of the filtered solution as a function of time can also be seen to be stable.